

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD – this document) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.

Puerto Rico Space Grant Consortium
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Grant Number: NNX10AM80H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Puerto Rico Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2014.

PROGRAM GOALS

Goal A: Increase the number of students pursuing undergraduate and graduate studies in STEM areas.

Objectives:

- Provide fellowships and scholarships to STEM students participating in projects pertinent to NASA.
- Strengthen existing graduate programs by sponsoring research travel and internships at NASA centers for students and faculty.
- Provide research experiences to STEM undergraduates at four-year colleges.

Goal B: Enhance PR's research capability and infrastructure in areas relevant to NASA.

Objectives:

- Provide seed grants in areas relevant to NASA as evidenced by collaborations with NASA centers.
- Promote college-level hands-on hardware projects: such as robotics, balloon sat and rock sat projects.

Goal C: Infuse pre-college education with exciting STEM activities to increase students' interest in STEM careers.

Objectives:

- Provide a range of professional development workshops for in-service and pre-service teachers.
- Promote the incorporation of NASA-related science topics and content in the pre-college classrooms through teacher workshops that make use of NASA content and NASA educational materials.

Goal D: Disseminate exciting information about NASA to the general community to build support for the enhancement of STEM education and research.

Objectives:

- Involve mass media in the dissemination of news about NASA accomplishments and NASA spinoffs that enhance our quality of life.
- Support the training of pre-service teachers as general public educators through internships at science museums and similar facilities.

PROGRAM BENEFIT TO OUTCOME 1

The NASA Internships, Fellowships and Scholarships (NIFS) Program has the objective to recruit and train U.S. citizens, especially women, underrepresented minorities, and persons with disabilities for careers in aerospace science and technology. Alumni that participated in PR Space Grant NIFS Program were hired by NASA, National Labs, or the Aerospace Industry, as follows:

- Dr. Dionne Hernández - NASA Glenn Research Center (GRC)
- José F. Martínez - NASA Goddard Space Flight Center (GSFC)
- Miguel De Jesús - NASA Johnson Space Center (JSC)
- Eframir Franco - National Astronomy and Ionosphere Center (NAIC)
- Erick M. García - US Caribbean Coastal Ocean Observing System (CariCOOS)
- Javier Guzmán - Infotech Aerospace Services
- Jason O. Trinidad - MotionDSP
- Gerardo Irizarry - Positronics Enterprises

PROGRAM BENEFIT TO OUTCOME 2

The Pre-College Program has the objective to promote a strong science, technology, engineering, and mathematics education base from elementary through secondary levels. The teams of the University Gardens High School of San Juan, Puerto Rico, and Rafaelina Lebrón Flores High School of Patillas, Puerto Rico, won the first and second place, respectively, in the High School Division of the new NASA Rover Challenge (formerly NASA Great Moonbuggy Race) that was held on April 17-18, 2015, at the U.S. Space and Rocket Center in Huntsville, Alabama. Organized by NASA's Marshall Space Flight Center, the NASA Rover Challenge is focused on designing, constructing and testing technologies for mobility devices to perform in different environments, and provides valuable experiences that engage students in the technologies and concepts that will be needed in future exploration missions. Rovers are human-powered and carry two students, one female and one male, over a half-mile obstacle course of simulated extraterrestrial terrain of craters, boulders, ridges, inclines, crevasses and ruts. Each student team of six members is responsible for building their own rover, and the two course drivers must be chosen from the team. As part of the challenge, and before traversing the course, unassembled rover entries must be carried by the drivers to the course starting line with the unassembled components contained in a volume of 5x5x5 feet (dimension requirements). At the starting line, the entries are assembled, readied for racing, and evaluated for safety.

PROGRAM BENEFIT TO OUTCOME 3

The Informal Education Program has the objective to encourage interdisciplinary training, research and public service programs related to aerospace. The Puerto Rico Astronomy Society Affiliate implemented a comprehensive agenda of outreach activities and monthly solar and nightly observation educational activities for the general public known as “Star Parties” reaching over 10,000 participants from the general public. The activities were carried out at schools, colleges, nonprofit institutions, and public parks across Puerto Rico.

PROGRAM ACCOMPLISHMENTS

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals. (Employ and Educate)*

- a. Fellowships/Scholarships Program: PRSGC provided full support (stipend and tuition) to 23 college students during the 2014-2015 academic years: 10 PhD students, 4 MS students, and 9 BS. The demographics of the student fellows are 96% Hispanic US citizens, 57% male and 43% female. The recipient students participated in NASA-related projects developed by researchers in the Jurisdiction in

collaboration with NASA centers. The participating projects include topics in: Astrophysics, Civil & Environmental Engineering, Computer Science, Control Systems, Electrochemistry, Nanotechnology, Fuel Cells, Materials Science, Theoretical Physics, Marine Science, Inorganic Chemistry and Biochemistry. The collaborating research centers include: Marshall Space Flight Center, Kennedy Space Center, Glenn Research Center, Langley Research Center, Goddard Space Flight Center, Johnson Space Center, Ames Research Center, Institute for Functional Nanomaterials.

- b. Research Internships Program: PRSGC supported ten students doing research internships during the academic semesters and summer session. The award covered travel costs and full stipend during the internship period. The host research centers include: Langley Research Center, Glenn Research Center, Goddard Space Flight Center, Johnson Space Center, Ames Research Center, and Jet Propulsion Lab.
- c. Research Infrastructure Development Projects: PRSGC supported ten seed projects relevant to NASA in collaboration with NASA centers. A total of eleven faculty members and seven college students participated in these projects. The seed projects involved the participation of four affiliate member institutions: University of Puerto Rico at Mayagüez, University of Puerto Rico at Río Piedras, University of Puerto Rico at Bayamón and University of Puerto Rico at Humacao. The following institutions collaborated in the seed projects: NASA AMES, NASA Goddard Space Flight Center, NASA Langley Research Center and NASA Kennedy Space Flight Center, Center for Advanced Nanoscale Materials, and the Institute for Functional Nanomaterials.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty. (Educate and Engage)*

- a. Hardware Projects for Undergraduate Students: PRSGC supported five hands-on hardware projects that involved 150 students and 8 faculty members. They were developed by three different affiliate institutions: University of Puerto Rico at Río Piedras, University of Puerto Rico at Humacao, Inter American University of Puerto Rico. The participating affiliate institutions received expertise and support from: NASA Goddard Space Flight Center, NASA Marshall Space Flight Center, NASA Wallops Flight Facility and National Undergraduate Research Observatory. The Higher Education projects included: development of a satellite engineering course using the CubeSat platform, two meteorology instrumentation courses using the RockSat platform, and the NASA Rover Challenge. By participating in these projects, the students gained technical knowledge relevant to NASA and became better prepared to lead a successful career in STEM.
- b. Pre-service Teacher Experience: PRSGC supported four pre-service STEM teachers to obtain an innovative teaching experience at STARBASE Puerto Rico and the National Astronomy and Ionosphere Center (Arecibo Observatory). STARBASE is a

premier educational program, sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs. At STARBASE, pre-college students participate in challenging "hands-on, mind-on" activities in STEM. The program's curriculum provides 25 hours of stimulating experiences divided in five weekly visits. STARBASE Puerto Rico training site to provide premier teaching experiences to pre-service teachers in order to prepare them to educate the highly skilled American workforce that can meet the advanced technological requirements of the Nation.

- c. Experimental Astronomy Research Experience for Undergraduate Students: PRSGC supported ten students to do mentored undergraduate research at the National Undergraduate Research Observatory (NURO). NURO is a consortium of primarily undergraduate education institutions from around the country, both public and private, that have joined together to provide training and research experiences for their students. Together they share 120 nights per year on Lowell Observatory's 31-inch telescope, with instrumentation and observer support provided by Northern Arizona University through its Department of Physics and Astronomy. Astronomers and students at the member schools collaborate on key research projects through NURO.
- d. Summer STEM Academy for Pre-college Students: The University of Puerto Rico at Arecibo Affiliate implemented a Summer STEM Academy to motivate pre-college students to study careers in STEM with innovative and modern workshops and topics that they do not get in a traditional classroom. A total of 25 students from 8th grade participated in the Academy. Conferences and workshops included the following topics: Robotics, Geology, Chemistry, Ecology, Fractals, Science and Technology Aerospace, Engineering, Astrobiology and Astronomy.
- e. Saturday Robotics Academy for Pre-college Students: This Saturday Robotics Academy was offered by the University of Puerto Rico at Arecibo Affiliate to 20 students of 7th-8th grade from eight different public and private schools of the Department of Education of Puerto Rico. The Lego Mindstorm robot was used as a tool to present basic STEM concepts, such as velocity, force, gear, efficient design and programming. They had experiences in the solution of problems while working as teams. The goal was to foster an early interest in STEM careers.
- f. Training Activities for Educators: A range of training activities were implemented in order to provide new NASA content and NASA educational materials to in-service teachers, pre-service teachers, and informal educators. A total of 950 educators attended these training activities and 80% of them reported bringing some of the new science content learned into their teaching. College faculty and students helped to organize the pre-college activities, exerted leadership in their implementation, and also became participants who benefited from the activity. The training activities were carried out by 10 affiliate institutions: UPR-Mayaguez, UPR-Río Piedras, UPR-Humacao, UPR-Arecibo, Ana G. Méndez System, Inter American University, PR

NASA Explorer School, PR Department of Education, Univision-PR, StarBase-PR. The activities also involved the participation of non-affiliate organizations: NASA Dryden, NASA Goddard Space Flight Center, NASA Kennedy Space Center, NOAA, PR Department of Education, PR Seismic Web, PR Emergency Management Office.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission. (Engage and Inspire)*

A range of educational projects targeted at the general public were implemented in order to bring NASA science and technology into the realm of the commonly heard of and spoken about topics in Puerto Rico with the purpose of: (a) planting the idea of pursuing STEM careers in children and youngsters and (b) increasing the overall societal esteem for STEM career paths, so that adults provide positive feedback to young people who express interest in STEM careers. The Informal Education Projects included astronomy observations for the community, NASA astronaut visits, conferences open to the general public, and demonstration/information booths in malls. The public-at-large NASA enrichment activities were carried out throughout the 2014-2015 academic year attracting a total of around 20,000 participants. Six affiliate institutions participated in organizing the activities: PR Astronomy Society, Univision- PR, UPR-Arecibo, UPR-Mayagüez, Ana G. Méndez, and UPR-Río Piedras. The activities also involved the participation of NASA centers and non-affiliate organizations: NASA Dryden, NASA Kennedy Space Center, NASA Glenn Research Center, Institute for Functional Nanomaterials, and the National Oceanic and Atmospheric Administration.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Diversity:** Out of 175 significantly-supported participants, 99% are Hispanic U.S. citizens. Their gender distribution is as follows: 48% (85) female, 52% (90) male.
- **Minority-serving Institutions:** 10
The ten Minority-serving affiliate institutions are strategically located, covering all geographical regions and socio-economic levels across the Jurisdiction. All of the PRSGC projects and activities involve Minority-serving institutions and Hispanic U.S. citizens.
- **NASA Education Priorities:**

Authentic, hands-on student experiences in science and engineering disciplines: PRSGC supported five hands-on hardware projects that involved 150 students and 8 faculty members. The projects included: development of a satellite engineering course using the CubeSat platform, two meteorology instrumentation courses using

the RockSat platform, and the NASA Rover Challenge. By participating in these projects, the students gained technical knowledge relevant to NASA and became better prepared to lead a successful career in STEM.

Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise: A range of training activities were implemented in order to provide new NASA content and NASA educational materials to in-service teachers, pre-service teachers, and informal educators. A total of 950 educators attended these training activities and 80% of them reported bringing some of the new science content learned into their teaching.

Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers: The University of Puerto Rico at Arecibo Affiliate implemented a Summer STEM Academy to motivate pre-college students to study careers in STEM with innovative and modern workshops and topics that they do not get in a traditional classroom. A total of 25 students from 8th grade participated in the Academy. Conferences and workshops included the following topics: Robotics, Geology, Chemistry, Ecology, Fractals, Science and Technology Aerospace, Engineering, Astrobiology and Astronomy.

Enhance the capacity of institutions to support innovative research infrastructure activities to enable early career faculty to focus their research toward NASA priorities: PRSGC supported ten seed projects relevant to NASA in collaboration with NASA centers. A total of eleven faculty members and seven college students participated in these projects. The following institutions collaborated in the seed projects: NASA AMES, NASA Goddard Space Flight Center, NASA Langley Research Center and NASA Kennedy Space Flight Center, Center for Advanced Nanoscale Materials, and the Institute for Functional Nanomaterials.

IMPROVEMENTS MADE IN THE PAST YEAR

The Consortium has refined its strategies by devoting significant efforts and investments to three high-impact student hardware projects (i.e., CubeSat, RockSat, and Lunar Rover) and having the affiliates align their efforts accordingly towards these hardware projects. The feedback from the External Advisory Board helps to steer the projects in alignment with NASA priorities. The Board members also help the investigators in making relevant connections/networking with NASA scientists and engineers.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

- UPR-Central Administration: lead institution and Jurisdiction-level management
- UPR-Mayagüez (Public Hispanic Serving Institution, Research University): undergraduate research, graduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- Mayagüez Planetarium (Museum): pre-college education, outreach projects
- UPR-Río Piedras (Public Hispanic Serving Institution, Research University): hardware projects, undergraduate research, graduate research, UPR-Humacao: hardware projects, undergraduate research, in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Cayey (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education, outreach projects
- UPR-Arecibo (Public Hispanic Serving Institution, Four-year College): in-service teacher training, pre-service teacher training, pre-college education, outreach projects
- UPR-Bayamón (Public Hispanic Serving Institution, Four-year College): undergraduate research, pre-college education, outreach projects
- UPR-Carolina (Public Hispanic Serving Institution, Four-year College): pre-college education, outreach projects
- Ana G. Méndez University System (Private Hispanic Serving Institution, Four-year College): in-service teacher training, pre-college education
- Interamerican University at Bayamón (Private Hispanic Serving Institution, Four-year College): hardware projects, undergraduate research
- PR NASA Explorer School (Public Middle School): hardware projects, in-service teacher training, pre-college education, outreach projects
- Arecibo Observatory Visitors' Center (Museum): undergraduate research, graduate research
- PR Department of Education (State Government Agency): in-service teacher training, pre-college education
- EcoExploratorium (Museum): pre-college education, outreach projects, informal education
- StarBase-PR (Federal Educational Facility): pre-service teacher training, pre-college education